

RAPID DETECTION OF INFECTIOUS DISEASE OUTBREAKS

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Introduction

Wargamers, screenwriters, and novelists have described the impact of a microbial invasion on the United States. Military, law enforcement, and public health authorities have long predicted and planned for a deadly infectious disease outbreak in the United States, either intentionally introduced by terrorists or through a natural worldwide outbreak of a killer flu. In fact, multiagency exercises have confirmed that the ability to detect and track an outbreak is essential in dealing with this challenge. Early detection is particularly important for a quick and effective initial response. Tracking the potential epidemic is essential for managing the ongoing response, targeting resources, and evaluating intervention effectiveness.

Earlier detection of illness syndromes at the community level can greatly reduce the time needed to identify an outbreak. This results in a more rapid response and a significant reduction in illness and death. The response could include targeting limited assets (e.g., personnel and drugs), equipping civil government leaders with outcome-based "exposure" estimates, and using risk communication methods to

reduce the spread of panic and civil disruption.

DOD-GEIS

The Department of Defense-Global Emerging Infections Surveillance and Response System (DOD-GEIS) was established in 1997 to promote surveillance of emerging infections, integrate and improve public health practices, enhance response capabilities to new disease outbreaks, and support training and capacity building to combat emerging infections. The hub of the DOD-GEIS, located at the Walter Reed Army Institute of Research (WRAIR), works closely with all branches of the military in both CONUS and overseas locations.

ESSENCE

DOD-GEIS is a leader in developing a prototype community-based medical surveillance system called ESSENCE (Electronic Surveillance System for the Early Notification of Community-based Epidemics). ESSENCE is used for the early detection of infectious disease outbreaks in military populations.

In May 2001, DOD-GEIS was awarded Defense Advanced Research Projects Agency (DARPA) funding to continue developing an advanced biosurveillance system called ESSENCE II. For this project, DOD-GEIS teamed with several institutions under the leadership of the Johns Hopkins University Applied Physics Laboratory (JHU/APL). The focus of the 4-year project is to develop and transition an advanced, epidemio-

logically based biosurveillance system that will use diverse health indicator data to rapidly identify, define, and guide responses to bioterrorist attacks or other emerging infectious outbreaks in civilian, military, or mixed communities.

ESSENCE II will build on previous efforts by APL's biosurveillance system and DOD-GEIS ESSENCE. Other ESSENCE II team members include The George Washington University

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School of Public Health, the Johns Hopkins University Bloomberg School of Public Health, Carnegie Mellon University, Cycorp, and IBM. Total funding for the institutions participating in this collaboration is more than \$8 million.

ESSENCE currently tracks syndromes based on a patient's signs and symptoms recorded during a doctor's visit instead of specific diagnoses that may rely on laboratory or other diagnostic procedures. The syndromic surveillance system performs a daily analysis of outpatient data from Washington, DC, area military treatment facilities (MTFs). Emergency rooms and primary care, internal medicine, pediatric, family practice, flight medicine, and occupational health clinics are included in the system. Because of the unique nature of their patients, infectious disease clinics are also included. The surveillance system includes 104 clinics in 21 different locations within a 50-mile radius of downtown Washington, DC.

Coding

A Standardized Ambulatory Data Record (SADR) is generated and matched with patient demographic data for every patient encounter within DOD. The provider fills in the SADR with applicable diagnoses from the International Classification of Diseases, 9th Revision, Clinical Modification (ICD-9-CM), along with the patient's disposition and other data. All encounters are coded near the time of encounter even if the cause of illness is not evident during the visit. Most ICD-9 codes chosen reflect this prompt diagnosis and may include syndrome-based codes such as cough and fever in addition to presumptive diagnoses such as pneumonia or influenza.

The SADR information is sent to a centralized database at the Tricare Management Agency (TMA). Data are fed directly to a secure computer at DOD-GEIS, allowing daily capture

of data from the Washington area clinics. This information is usually received within 1 to 3 days of the initial patient visit. Most important, collection of these data puts no additional reporting requirements on clinicians or clinic administrators.

Because significant variability exists in reporting among providers and clinics, similar ICD-9-CM codes are grouped together in nine syndromes that best represent noticeable signs, symptoms, and diagnoses. Grouping the codes decreases the data's variability and allows more accurate monitoring of the patient visit types. Establishing baseline levels of these syndrome groups for the Washington area allows daily monitoring of fluctuations. Significant changes can be quickly detected.

Historical Data

Expected numbers of syndromes for each of the groups are calculated using historical data. The daily count of reported syndromes is plotted against the expected number of cases. Any data points significantly higher than the number of expected cases could signal an unusual increase or decrease in a reported syndrome.

Off-the-shelf geographic information software is used to map the reported syndromes using patients' home zip codes. The data used for geographical viewing are updated daily. Mapping data points helps determine if a syndrome outbreak includes a geographic component and may aid in locating the source of the disease outbreak. Mapping also helps in predicting the extent of the affected population.

System Expansion

ESSENCE II will greatly expand the current system. A key addition will be an alert system for notifying when any syndrome group exceeds its normal range, as well as appropriate response protocols. Other planned enhancements include cap-

turing a broader range of health indicator data such as pharmaceutical disbursements, laboratory requests and results, and radiological requests and results from MTFs. Other non-medical health indicators that will be explored include school absenteeism and transit usage. These would be a separate but complementary and confirmatory source of data for models.

The partnership with JHU/APL will allow military and civilian communities in the Washington, DC, area to incorporate and coordinate information. Developing a syndromic surveillance system that best serves the entire region is important. Including data from civilian emergency rooms and managed care organizations as well as other health indicators will greatly enhance ESSENCE II's ability to rapidly detect an emerging outbreak.

In the wake of terrorist attacks on Sept. 11, 2001, ESSENCE has been expanded into other areas of the United States with relatively large numbers of military personnel. All MTFs in the United States send data to the TMA system that can be obtained and analyzed in a similar fashion. DOD-GEIS is exploring collaboration with other public health personnel in the military to set up similar systems in their locations.

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